Smart Dairy Farming for Sustainability

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Smart dairy farming (SDF) is the key concept that can satisfy the increasing demand of quality dairy products. SDF can reduce the environmental issues, decrease the use of resources, and raise the animal health by using advanced sensing and data analysing technologies. Dairy farmers are in the era of precision farming which is considered to be more important for information provision and for capturing competitive market, hence the need for a variety of data sources that contain the dynamic and static cow data about feeding, calving, nutrition, insemination, and the process of milk production. Internet of things started influencing the milk production.

The farm owner can place the sensor onto the cow's neck, tail, or leg for acquiring real time data to examine numerous factors like cow's behaviour, activity, health, feed consumption, milk production, and fertility management. These wearable sensors can spot cow's illness and diseases such as mastitis or any other disease that can reduce milk production.

Framework for Smart Dairy Farming

A wearable sensor for capturing data from cows will send data to the nearest gateway and, with the help of Internet, the data will be transferred to a base station. The base station sends the data to cloud, and the cloud will analyse data using different techniques and methods. IBM cloud with IoT-based platform analyses the data with respect to different procedures; for example, when the sensor detects the cow hunger need, then the automated system will feed the animal.

Smart dairy farming which is IoT enabled has some herd management techniques for maintaining the logs and historical data. With this data the farmer can also predict the future data according to the environment of the cow. After analysing the captured data, the cloud will send the alerts to the farmer for assisting the cow. This herd management system can be applied to large-scale dairy farming when there are a lot of animals. The system will automatically detect the need and send alert to the farmer. There are many factors that can cause lower milk production, but this overall architecture can create a comfortable environment for a cow. It will be helpful for cows and ultimately can increase milk production.
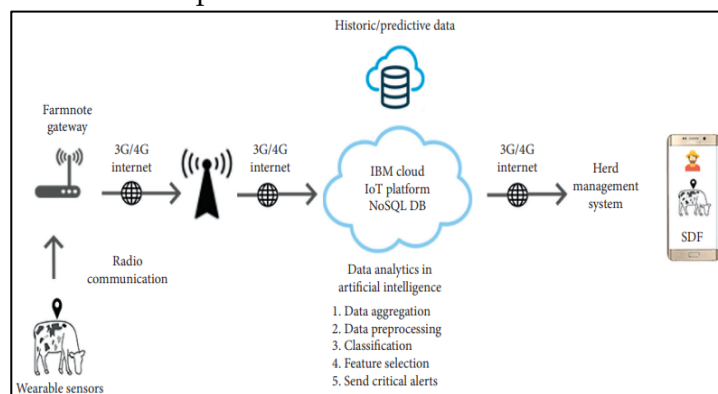

Fig. 1. Framework for SDF
Source: **Akbar** *et al.,* **2020**

Innovation in Smart Dairy Farming

Innovation in smart dairy farming is related to innovation in production (milk yield) and process of dairy farming. Dairy farm owners are the forefront for the farming innovation. Process innovation can be different set of activities that can be done at different levels in a smart dairy farm. In a dairy farm, only milking process can be seen as singular process, but on the other hand there are many activities that are performed in the farm like feeding, cow monitoring, and preserving milk. Innovation can be in different procedures like the feed system that can sense the hunger need of the cow and automatically feed the cow and automatic heat detection that will assist in reproduction as shown in Figure 2.

Assessing health and monitoring cows for disease detection and prevention will help the farmer to locate any animal that needs medical attention. The smart dairy farming includes real time sensors that collect data from cows with the help of wearable smart collars, machine learning data analysis, and cloud-

based data centres that manage data and support the farmer in order to manage quality of dairy products as depicted in Figure 3.

Feature of Smart Dairy Farming

Dairy Farming Features. Internet of things and data driven techniques are creating greater opportunities for smart dairy farming. Different features and their benefits are described here.
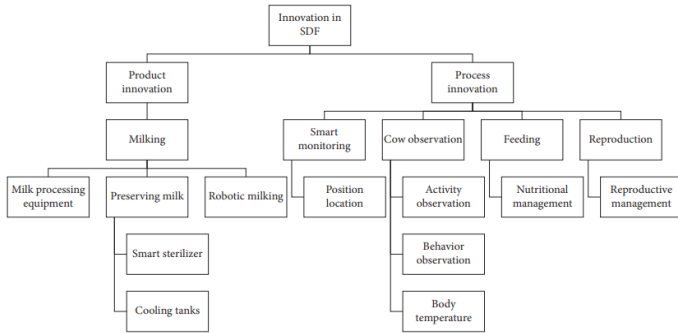

Fig. 2. Innovation in smart dairy farming
Source: **Akbar et al., 2020**

Conclusion

The demand for milk is continuously increasing due to increasing population of the world. The consumption of the dairy products is more in developed countries as compared to developing countries. To meet this increased demand for milk products,

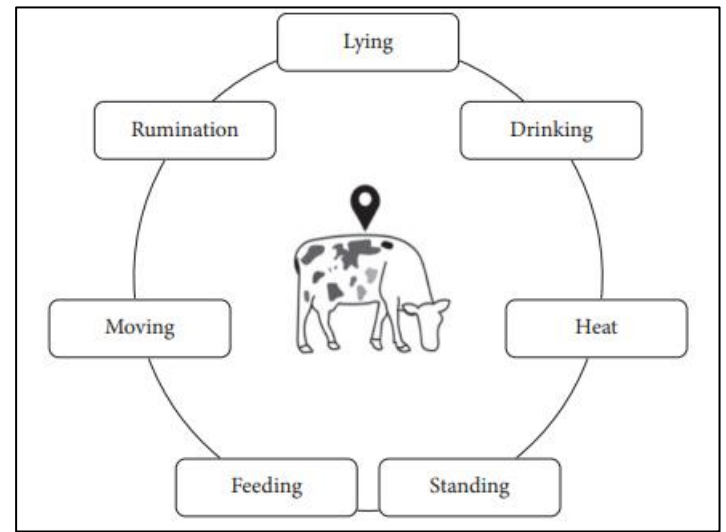better technological techniques for improving milk yield are required.

Fig. 3. Sensors for Smart Dairy Farming
Source: **Akbar et al., 2020**

Reference

Akbar, Muhammad & khan, Muhammad & Hussain, Azfar & Qaiser, Ghazia & Pasha, Maruf & Pasha, Urooj & Missen, Malik Muhammad Saad & Akhtar, Nadeem. (2020). IoT for Development of Smart Dairy Farming. Journal of Food Quality.

Table 1. Feature of Smart Dairy Farming and their applications

SDF feature	Subcategory	Applications	Description	Benefits	Short-comings
Smart monitoring	Position Location Tracking Activity	Geofencing RFID auto tracking	Approaching and treating each animal individually	Low labour cost Less use of resources More productivity	High setup Cost
Cow observation	observation Behaviour observation Body temperature	Sensor-enabled technology Automatic disease detection	Milk yield, milk conductivity, animal activity	Improved cow health Detection of disease at early-stage Low rate of death	
Feeding	Nutritional management	Automatic concentrate feeder	Supply feed depending on yield	-	-
Milking	Preserving milk Robotic milking	Auto milking	Milking procedure according to the health and age of the cow	-	-

Source: **Akbar et al., 2020**

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